TECHNICAL NOTE

Filing Code 1265.13 (P-410)
Date Issued June 1970

Bureau of Land Management U.S. DEPARTMENT OF THE INTERIOR

MATHATRONICS PROGRAMMABLE ELECTRONIC CALCULATOR

The Mathatron System is composed of the following: Surveyor 848-C, Auxiliary Program Storage (APS) and Mathatypier with paper tape punch and dual paper tape readers (MPTP).

The heart of the system is the Surveyor 848-C. It is a solid-state electronic calculator requiring no warm-up period. Forty-eight steps of memory and eight storage registers are available. Dynamic range is 9-digits plus exponent 10-42 to 10+58. Answers are accurate to 8-digits. A built-in serial strip printer records input and answers.

Single stroke keyboard operations are: 0-9 numeric, decimal, exponent, square root, addition and subtraction. Two stroke keyboard operations are: multiplication, division and right-left parenthesis for mathematical chain multiplication and division.

Ten prewired programs are available: inverse, arc-tangent function, sine function, cosine function, four-quadrants (NE, NW, SW, SE), radians to degrees and traverse balance (transit rule).

With the addition of the APS, the Surveyor 848-C is expanded to 480 steps of memory, forty-eight storage registers, and up to eighteen prewired programs. If desired, the 480 steps of memory can be converted to forty storage registers for a total of eighty-eight storage registers.

The MPTP is a mathatronics modified Model 33 ASR Teletype. Its main purpose is as an input-output device with auxiliary program memory in the form of punched paper tape. Input is either punched paper tape or keyboard.

Output is a fully formated 8½ inch wide typed record. When using the PTP for output, the Surveyor 848-C's printer is suppressed. All the Surveyor 848-C keyboard operations are accessed by coded commands from the MPTP keyboard.

The MPTP is provided with dual tape readers so that the program and input data can be read automatically. A tape punch is provided so that input tapes can be prepared off line and edited, thus reducing input errors.

The system is flexible and can be programmed in three configurations: Program Memory Core (PMC), Auxiliary Program Tape (APT), or a combination of Program Memory Core and Auxiliary Program Tape (PMC-APT). The PMC is set up for fairly sophisticated programming. Branch, branch and return, conditional and unconditional stops and logic decisions are available. The APT is easily programmed, whereas the PMC would be classified as a little more difficult. See Example 1 for sample of programming.

The system is fairly portable. It breaks down into three basic components which are easily carried in a sedan delivery. Because the MPTP's operating components are mechanical rather than electronic, due caution must be exercised in transporting it.

We used the system in the APT configuration because our programs were generally too large for the PMC and required maximum data storage. The programs varied between 360 steps and 1,300 steps. All programs were developed for a fully automatic process of computing. The program containing 1,300 steps takes approximately five minutes to run.

Input data tapes are prepared and edited off line. This resulted in a more efficient use of the system's computing time as erroneous computations resulting from incorrect input is reduced.

The system would handle all but two of the necessary computations for an Airborne Control (ABC) Survey. The conversion of State Plane Coordinates programs required 10-place accuracy which is beyond the capabilities of the system.

The speed of the system proved too slow to handle the large volume of input data associated with an ABC Survey.

Although the system proved inadequate to handle the computation on an ABC Survey, it would be more than adequate for a photogrammetric or conventional cadastral survey. The Surveyor 848-C, by itself, would make an excellent desk calculator for most engineering applications.

Example 1

Programming Sample

Problem - Reduce a slope distance (meters) to horizontal distance (feet) at sea level.

Given - Slope distance (meters) and elevation (feet) at each end.

Terminology - HD = Horizontal Distance.
HDSL = Horizontal Distance at Sea Level.
SD = Slope Distance.
E = Elevation.

Calculations - $HD = ((SD)^2 - (E-E_1)^2)^{\frac{1}{2}}$

$$HDSL = HD \left(1 - \frac{\frac{(E + E_1)}{2}}{2089000}\right)$$

This program assumes all constants and input variables have been loaded into storage.

Input - SD$10 E$11 $E_1$$12

Program Listing - #10*#20$10#11-#12$40#10*#10-#40*#40>

$40#40-#40(#11+#12)/(#21*#22)$10#10=

Storage Registers - 20, 21, and 22 are constants.

Program terminology:

#XX - Storage register XX

$XX - Store value in display in storage register XX

* - Multiplication

/ - Division

\- - Subtraction

\+ - Addition

\> - Square Root

= - Display

Program is written exactly as one would work a problem on the keyboard. This problem required 72 program steps. Program is for example purposes only and has not been streamlined.